

SOME SAN DIEGO COUNTY PLEISTOCENE NOTES.

By Frank Stephens.

The Pleistocene exposures in San Diego county are along the sea coast, the greater number being close to the beach of ocean or bay. Their elevation above the present sea level varies from at or below sea level to nearly one hundred feet above the sea. Taken as a whole the elevation after the strata were deposited was nearly uniform, though there are some local differences of a few feet. There are some differences between the strata on the ocean front and those on San Diego and Mission Bays and they are probably not contemporaneous, the ocean front probably are younger. Before the time when these Pleistocene deposits were laid down an elevation of the whole region had extended the dry land several miles westward. Then a period of depression occurred, continuing until the sea beach was a short distance further inland than the present sea beach. This was probably when the fossil shell deposits at San Diego and Mission Bays were laid down. Then a few feet more depression occurred. The land remained stationary a long time and the sea cut a terrace along the water front.

This terrace is distinct along the west side of Point Loma and probably extended along the coast for many miles as traces of it can be found in many places. The sea level at this time was nearly one hundred feet above the present sea level and the shore line was very different from the present shore line. There were no San Diego and Mission Bays. Point Loma was an island. There were small bays at the mouths of the rivers. The accompanying sketch map shows how the shore line would look if the land was now depressed one hundred feet. It is based on the one hundred foot contour line of the San Diego and La Jolla Quadrangles of the U. S. topographic surveys. As the contact between the Pleistocene strata of the terrace and the underlying rocks is distinct and varies but a very few feet ~~xxx~~ from the horizontal in many miles it is practically certain that the sketch map shows where the shore line was just before the last elevation. Later the land rose to its present position and the sea began cutting a new terrace. It has worn away much of the old terrace, in places even the whole of it. On Point Loma the remnant varies from a few yards to a quarter of a mile in width. From Torrey Pines to Mission Bay it is all gone in places only a few fragments being left, that one on which Pacific Beach is built being the largest. Given time enough the sea will get these too. "The mills of the gods grind slowly, but they grind exceedingly fine". These Pleistocene deposits should not be confused with the shells of edible species found at ancient Indian camp sites and villages ('kitchen-middens') found in many places along the coast. These shells are of few species, but often contain small shells and therefore may be misleading. These small shells are usually young individuals of the edible species.

Identification of the species was made by Mrs. Kate Stephens. She has examined all the shells collected at the various localities herein described, numbering several thousand specimens. Practically all the species found are now living in the ocean, some are southern scarcely, or not now, found this far north. More are northern species. This shows a former variation in the ocean currents.

Localities Examined.

The numbers used are those of entries in the Geological Record of the San Diego Society of Natural History.

SDSNH # 118. International Boundary Monument #258 is on a mesa a few yards from its edge, at the Pacific Ocean. This mesa is a terrace about 75 feet in altitude at the beach and about 150 feet where it abuts against the hills eastward. The terrace is about half a mile in width. Northward it is bounded a quarter of a mile from the international boundary by the Tijuana River bottom. The sand beach in front of the terrace is a hundred yards or more in width. On it are some small sand dunes. The bank at the edge of the terrace is a steep, soil-covered slope carrying a considerable growth of brush. This soil hides the edge of the more or less consolidated sand and clay underlying the terrace and rock exposures are very few. 75 yards north of monument 258 a small ravine cuts through the talus and exposes a fossiliferous stratum about 40 feet below the edge of the terrace and about 30 feet above the sea. This stratum is about a foot thick and contains an abundance of fragments of large bivalves. These fragments are so thoroughly broken that very few can be recognized specifically. By sifting I obtained a number of univalves mostly small species. The material underlying the fossiliferous stratum appears to be a soft sandstone. That over it is sand and clay, poorly consolidated except a hard stratum of sandstone near the top of the slope. The species most abundant found here are - *Acularia perperus*, *Alectrion fossata*, *Columbella carinata*, *Conus californicus*, *Grepidula adunca*, *Dentalium neohexagonum*, *Olivella costica*, *Tellina maropsis*, *Turpinella* sp.

SDSNH # 119. About a quarter of a mile from the ocean a ravine crosses the international boundary east of monument 258. It runs northward to the Tijuana River bottom. About 200 yards north of the boundary in the bank west side of the ravine a fossiliferous stratum is exposed. It is about a foot thick and is composed of material similar to that of #118, and, like it, is exposed but a few feet in length. About 25 yards south of this exposure is another small exposure of this fossil bearing stratum. As the fossils appeared to be like those of #119 I did not collect any of them.

From composition, situation and altitude I believe #118 and #119 are a part of the same stratum, and that this stratum underlies the terrace possibly as far back as the wave cut terrace extends, and that the overlying material was worn away from the hills partly by wave action and partly by erosion. After later elevation the sea wore away the edge of the terrace and built a sand beach in front of the bank.

The species most abundant are - *Acularia perperus*, *Columbella carinata*, *Conus californicus*, *Grepidula adunca*, *Dentalium neohexagonum*, *Glycimeris septentrionalis*, *Kellia laevis*, *Ostrea* sp., *Olivella pedroana*, *Tellina bodegensis*.

SDSNH # 54 Twenty sixth Street at San Diego Bay. This locality is marked on the San Diego Quadrangle as Indian Point. The fossil deposit is at the bay shore and extends a block each way from the foot of 26th. street. The Santa Fe railroad is graded along the bank and exposes some of the deposit. The grade cuts through the point. The principal deposit of shells is on the outer side of the point. It extends from 15 or 20 feet above tide to an unknown distance under water. Shells of several species are abundant. They are in coarse sand, usually loose, cemented with lime in places. There is considerable "kitchen midden" material on the terrace at the top of the bank and some of the shells have been washed down on the face of the bank. The species most abundant are - *Cardium substriatum*, *Chione undatella*, *Cocculum* sp., *Crucibulum spinosum*, *Diplodonta sericata*, *Dosina ponderosa*, *Laguna unifasciata*, *Macoma californica*, *Macoma californica*.

SDSN# 55. Greely Street south of 32nd. Street. About two thirds of a mile from San Diego Bay [In a bank south side of a ravine - old railroad grade in the ravine. Alt. about 40 feet. There is a sandstone stratum, cemented with lime, that contains many fragments of shells and a few whole ones, but they are soft and crumble in extracting. Overlying this stratum is soil that contains scattered shells that are better preserved. They probably were wearhered out of a higher stratum. Soil and rubbish have been duged over the bank and obscure its face. The commonest shells here are - *Chione succincta*, *Ostrea lurida*, *Pecten circularis* and *Phacoides nuttalli*.

When San Diego City (('New Town')) was first settled fresh water used by the inhabitants was obtained from wells. One of these wells was in the lower end of Cabrille Canon, in the southwestern corner of Balboa Park. According to the contours of the San Diego Quadrangle this is about the 100 foot contour. In digging the well fossil shells were found, which fact was reported to Mr. Henry Hemphill, a conchologist then living in San Diego. Mr. Hemphill made a collection of over a hundred species of shells from this well. These were sent to Dr. Dall for identification. Dr. Dall reported on them in Proc. Sal. Academy of Sciences, V 1874, and in Proc. U. S. National Museum Vol I 1878, pp 10 - 16 and pp 20 - 30. The shells were obtained at a depth of 90 to 160 feet from the surface, therefore at and below sea level. This well was about a mile from the bay. Shells were found in other wells also, but not in as much abundance as in this one. No report of the relative abundance was made, but Dr. Dall makes some comments on their distribution. "Ten species are extinct and ninety seven are still found living. Of those recent or still living forms twenty are found in the California fauna and northward at the present time. Eighteen more are found in the California fauna and southward, while forty four are strictly Californian. Besides there are eight species belonging to the Oregonian or Arctic fauna and no longer found living in the Californian region. Seven more are found on the west coast of Mexico, the Gulf of California, or western Middle America, and so far as we know, no longer in the Californian region."

SDSN# 56. Spanish Bight. A bridge across the Bight is the principal connection between Coronado Beach and the aviation grounds on North Island. A cliff 20 to 25 feet in height along the east side of North Island borders the Bight, which at high tides reaches the foot of the cliff. A hundred yards south of the west end of the bridge a coquina deposit composed principally of *Donax* commences. In the upper part of the deposit the shells are rather firmly cemented together, but lower they are less cemented, often being loose in sand. The *Donax* deposit is a dozen feet or more in thickness and is overlaid with a few feet of soil. It extends about a hundred yards southward where it rather abruptly becomes considerably less abundant in *Donax* and other species come in, rather sparingly at first but more abundantly further on and occasionally in bunches. These fossils occur in gray sand. The face of the cliff is usually covered with a few inches or two or three feet of soil which has been washed from above or dumped from the aviation grounds. Much rubbish has also been thrown over the cliff, in places covering the best of the collecting ground. This Spanish Bight locality has yielded the greatest number of species of any collecting locality along this part of the coast. Some of the species most abundant are - *Alectrion fossata*, *Aligena cerritensis*, *Columbella guapata*, *Dendraste excentrica*, *Dentalium neohexagonum*, *Crepidula auncia*, *ryptomya californica*, *Donax laevigata*, *Olivella biplicata*, *Olivella oetica*, *Pecten latiauratus*, *Tellina buttoni*, *Terebra pedroanum*, *Tivella tulporum*.

SDSN# 57. At Rosenkrans Street southwest from Dumas Street for two blocks street grading has exposed a deposit consisting principally of fragments of Ostrea lurida. The Ostrea fragments are a compact mass several feet in thickness. There are a few other species in small numbers. The altitude above the bay is 30 or 40 feet.

SDSN# 58 - 59 - 60 - 61 - 62 - 63 - 121 - 122 - 123 - 124 - 125 - 126 - 127 - 128 - Along the west coast of Point Loma, within a distance of four miles are a number of paleontological collecting localities. As they are all on the same Pleistocene strata I will describe them as a group. The only difference among them is the relative abundance of the species, caused by the difference of the ~~xxxxxxx~~ material of the fore shore from which they were originally transported by wave and current action; whether it was rock bottom, mud or sand. The preponderance of rock-dwelling species, such as limpets, chitons and mussels shows that in Pleistocene time the fore-shore was principally rocky, as it is now.

Along the western side of Point Loma there is practically no beach, the waves at mid- and high-tides beat against a rock cliff. At low tide a narrow rock or boulder beach may be exposed in places. The cliff is so near perpendicular that it can be scaled in ^{but} few places. The line of contact between the Pleistocene and the underlying older rocks can easily be distinguished all along the cliffs. The contact line is horizontal, varying so little from a true level for many miles that it requires close inspection, or the use of an instrument, to detect any variation. This is not the case with the underlying strata. It is seldom that they run horizontal any distance. The older rocks dip at various angles and in various directions, showing that they had been distorted by earth movements before the upper part had been cut away in Pleistocene time. A remarkable fact is that no such local disturbances have taken place since the Pleistocene strata have been deposited, as the variation in level of the Pleistocene strata is but a very few feet in the many miles along the coast. One exception to this condition must be noted. About a third of a mile from the southern extremity of Point Loma a fault occurred with a downthrow of about twenty feet on the south side. This fault occurred after the Pleistocene strata were deposited, as the drop in the contact line shows.

It may have occurred at the time of the last elevation of the land.

While the Pleistocene strata were being deposited the surf was at work wearing away the base of the bordering hills and forming a terrace. After the last uplift occurred the waves began on a new terrace and have already worn away much of the Pleistocene terrace which now varies in width along the west coast of Point Loma from a few yards to a quarter of a mile.

~~The commonest Pliocene species found along the west coast of Point Loma~~

The commonest Pleistocene species found along the west side of Point Loma are - Acmaea insissa, Acmaea limitula, Acmaea mitra, Acmaea pelta, Acmaea scabra, Aletes squamigerus, Cardita subquadrata, Chione undatella, Chlorostoma umbratile apertum, Conus californicus, Crepidula aculeata, Crepidula alunga, Chumminges lamellosa, Fissurella volcano, Leptothya carpenteri, Littorina scutellata, Lottia gigantea, Melanophthalma scutellata, Mytilus californicus, Papia staminea, Phacoides californicus, Pseudonema exogyra, Septifer bifurcata.

SDSNY # 64. At the northeast corner of Mission Bay is a cut made by the Santa Fe railroad. In the northern end of the cut is a deposit of Pleistocene shells. This extends below ditches on the sides of the track an unknown distance and up the bank eight or ten feet. In the cliff between the railroad and the bay is an exposure of Pliocene age, and at the waters edge is a stratum of Eocene age. The altitude of the railroad cut is 25 or 30 feet. Some of the species found here are - *Caritidea californica*, *Chione gnidia*, *Chione succincta*, *Macoma calcaria*, *Paphia staminea*, *Phacoides californicus*, *Phacoides nuttalli*, *Purpura haemostoma*, *Tagelus californicus*, *Pelania sericata*, *Tellina meropsia*.

SDSNY # 65. Crown Point was formerly known as Bay Point. It projects into Mission Bay from the north. Along the west side of its southern extremity is a deposit of Pleistocene age. This is a cemented mass composed principally of *Donax laevigata*, with a few *Astartes callosa*, *Chione succincta*, *Macoma secta*, *Paphia staminea* and *Tivella stultorum* scattered through the mass. In the lower part about high tide line *Dendraster excentricum* is common. The shell bearing stratum extends from the water ten to fifteen feet up the bank.

SDSNY # 66. Along the ocean front at Pacific Beach is a cliff 20 to 50 feet in height. Through about half a mile of the southern part of this cliff fossils are more or less abundant. The upper 5 to 15 feet of this cliff is Pleistocene, and the lower part is Pliocene. In the Pliocene a skull, ribs and vertebrae of some species of whalebone whale have been found. Pleistocene shells have been washed down over the Pliocene and are liable to be confused with Pliocene species. The contact between the Pleistocene and Pliocene is practically horizontal, but the Pliocene strata are non-conformable, the dip being southward. A careful collection of fossil shells from above the contact includes the following common species - *Acanthina paucilirata*, *Acmaea insessa*, *Alectrion fossata*, *Alectes squamigerus*, *Caliostoma canaliculatum*, *Columbella carinata*, *Columbella guasagata*, *Conus californicus*, *Crepidula adunca*, *Crepidula onyx*, *Cryptomya diadora* sp., *Donax laevigata*, *Fissurella volcano*, *Littorina scutellata*, *Olivella biplicata*, *Olivella pedroana*, *Paphia staminea*, *Polinices reclusiana*, *Tivella stultorum*.

SDSNY # 67. At the beach between La Jolla and La Jolla Vermeja are weathered out shells lying on the surface or a few inches in the soil, 15 to 35 feet above tide. I found no stratum, probably it is all weathered away. Conditions are much the same for some distance along the beach but I found no shells elsewhere. In the cliff a little further south the contact between the Pleistocene and the older rocks is plain, but I found no fossils there. Species found here are - *Acmaea limicola*, *Barnacles*, *Donax gouldi*, *Isochiton* sp., *Lottia gigantea*, *Mytilus californicus*, *Pseudochama exogyra*, *Septifer bilineata*.

SDSNY # 68. The Pleistocene terrace that once must have extended along the ocean side of the Torrey Pines ridge has been almost completely obliterated by the sea. At least one remnant is left. This is at the Stairway Canon, a mile or more south of the northern extremity of the ridge. This remnant extends a quarter of a mile or so southward from the stairway and nearly as far northward, but the northward part is much narrower, merely a shelf toward the end with but a thin fossiliferous stratum left over the contact. Evidently in Pleistocene time there was a cove or little valley at the lower end of the Stairway Canon which the surf widened and cut back beyond the elsewhere nearly straight face of the cliff and was therefore somewhat protected. In this cove and probably in that part of the terrace that has vanished, clay, sand and shells were deposited, forming the Pleistocene strata. The contact between the lower part of the Pleistocene strata and the Eocene below it is about sixty feet

feet above sea level. The Eocene strata are not fossil bearing at that height, but are richly fossiliferous at and a little above sea level, and Eocene fossils may be found in places near the top of the cliffs. 200 to 250 feet above sea level. At least 25 species of fossil shells occur in the Pleistocene strata. The most common species are - *Cummingea lamellosa*, *Donax gouldi*, *Donax laevigata*, *Isochiton* sp., *Mytulus californicus*, *Paphia staminea*, *Pseudochama exogyra*, *Tivella stultorum*, *Saxidomus nuttalli*.

SDSNY # 69. North side of San Dieguito valley, about two miles by road from Del Mar on the way to Rancho Santa Fe. About a mile from the sea. In the hillside north of the road is a Pleistocene deposit. In its eastern part the shells are weathered out and scattered over the hillside, with no stratum discernable. In the western part, in a small gulch is a stratum of lime cemented sandstone containing fossil shells, and near the gulch were what appeared to be blocks of the same stratum in the soil. The fossiliferous stratum is about 60 feet above sea level. Brush and soil obscure the situation, and no contact with older rock was found. A few hundred yards further east, at the roadside, is a stratum containing Eocene fossils. The most common species of the Pleistocene shells found were - *Aletes squamigerus*, *Chione seccincta*, *Chione undatella*, *Diplodonta sericata*, *Diplodonta subquadrata*, *Ostrea lurida*, *Phacoides nuttalli*, *Pecten aquisulcata*, *Pinna* sp., *Tagelus californicus*.

Pleistocene

No.

- 54 Foot of 26th St. Bay shore.
- 55 San Diego near Greely and 32nd streets
- 55a East of 32nd St. $1\frac{1}{2}$ blocks north of National Avenue
- 56 Spanish Bight.
- 57 Loma Portal, Rosencrans St. between Browning and Center streets
- 58 $\frac{1}{4}$ mile N.W. of the new lighthouse on Point Loma. At the beach.
- 58a $\frac{1}{3}$ mile N.W. of the new lighthouse, north of the fault.
- 59 Point Loma, about two miles N.W. of the lighthouse.
- 60 About $2\frac{1}{4}$ miles N.W. of the lighthouse.
- 61 From the second (or third?) gulch south of the north line of the military reservation on Point Loma.
- 61a On a point about 15 feet above the strata containing #61.
- 62 Point Loma, about $1\frac{1}{2}$ miles south of Ocean Beach. On the property of the Theosophists, 200 yards south of the S.W. corner of Sunset Cliffs
- 63 Ocean front at Santa Cruz Ave. Ocean Beach.
- 64 Northeast corner of Mission Bay. on Santa Fe RR right of way.
- 65 Crown Point (Bay Point on maps.) Mission Bay.
- 66 ~~Mission Beach~~ Pacific Beach. ocean front. from above contact with Pliocene
- 67 San Diego Valley. In bank on north side of the road to Santa Fe
- 68 Rancho, $1\frac{1}{4}$ miles from Del Mar 1 mile from the ocean
- 68 Torrey Pines, at mouth of the "stairway cañon."
- 69 South of La Jolla and a little north of La Jolla Hermosa
- 70 N.E. corner of Point Loma, near end of dykes.
- 71 Head of Batiquitos Lagoon, about two miles from the sea.
- 72 North side of the head of Batiquitos Lagoon, &
- 118 100 yards north of boundary monument 258. at sea beach.
- 119 400 yards north east of monument 258, west side of gulch.
- 120 ~~400~~ South of 119. 75 yards north of the boundary fence.
- 121 $\frac{3}{4}$ mile north of the new lighthouse, Point Loma
- 122 $\frac{1}{4}$ mile south of the "coal mine", Point Loma.
- 123 Point Loma, "coal mine".
- 124, $\frac{1}{4}$ mile north of the "coal mine", at foot of hill, upper edge of terrace.
- 125 ~~$\frac{1}{4}$~~ mile N.W. of Point Loma lighthouse, at mouth of same ravine as 124
- 126 ~~2 miles~~ N.W. of Point Loma lighthouse

Pleistocene

Locality number

- 127 Point Loma, near sea beach, west side $1\frac{3}{4}$ m. n. of lighthouse
- 128 Point Loma, $2\frac{1}{4}$ m. n. of lighthouse
- 129 at foot of extreme north end of Torrey Pine ridge at beach. Probably a slide,
- 187 1 mile south of boundary monument 258, at sea beach
- 188 South side Tijuana River, 500 yards east of the sea beach, 250 yards north of the boundary line
- 190 1 mile northwest of Newport Beach
- 199 In Lower California, $2\frac{1}{2}$ miles south of Monument 258
- ? 362 " " " at the shore of ~~the~~ the Gulf of California, 2 m. n. of San Felipe
- 343 } About 4? miles north of Rosarita, Lower California and perhaps a dozen miles south of boundary monument 258.
San Ysidro, Cal.

Pliocene

No

1a South end of Solidad Mountain,

3a " " " "

4 " " " "

5 " " " " above #4

7 " " " "

9 " " " "

on various gulches going westward

10. East of Chula Vista,

12 San Diego, below Kensington Park car line bridge, ^{see #160} West side of road

29 Balboa Park, south of the west end of Cabrillo Bridge, ^{see 189,}

45 About six miles east of Carrizo Station, from a mound north side of the road, this may be Blake's type locality. Imperial County, = 143a

47, About 5 miles west of south of the old Carrizo Station, on the north slope of a ridge running west from Coyote Mountain, San Diego County

47a Below #47 and 50,

50 From a stratum overlying #47,

54a In clay hills 5 m. S.E. from Carrizo Station Imperial County

51 ³ 3 miles east of the old Carrizo Station and one mile south of the road, Imperial County

66a, Pacific Beach, from below the contact with the Pleistocene ^{see #66, Pleistocene}

141. Pacific Beach,

142 About four miles SSE from Carrizo Creek Station, in the wash that heads in the gap in the ridge west of Coyote Mountain, Imperial Co

142 a Half a mile up the wash from #142,

143 7 miles east of the old Carrizo Station, on the summit of the hill where the road comes up from Carrizo Creek,

143 a Same as #45,

145 Barrett Canon in Black Mountain ^{5m} north of Carrizo Creek, Imperial ^{Co}

154 San Diego, Ruyard Way,

157 Sandrock grade below the Adams St bridge,

158 "Fossil Bone", Bonita-Chula Vista,

160 San Diego below Kensington Park bridge ^{see #12,}

167 San Diego, 6th St grade, below the Macey Hospital

168 " " Balboa Park, from the side of the old graded road west of the old camp of the marines

Phocene.

no

169. West of Mt. Hope Cemetery, along the lower entrance, East of Imperial Ave,
170. Near the golf course in Switzer Canon, Balboa Park
- 172 San Diego southeast of Reynard Way,
- 173 San Diego, Reynard Way, at the old brickyard site
- 175 Barrett Canon, 7 miles from Carrizo Creek, Imperial County
- 176 $\frac{1}{2}$ mile south of the upper end of Split Mountain Canon, In Imperial County probably, but near the San Diego County line,
- 177 San Diego, near the Adams St. car barns, (1 block N.E.),
- 178 San Diego, near Fir and Boundary Streets (Glen),
184. 4 miles east of the old Carrizo Station and $\frac{1}{2}$ miles south of the Carrizo wash,
- 189 San Diego, Balboa Park, 400 yards south of the west end of Cabrillo bridge, Same as no 29
- 346 Yuha Buttes, Imperial County, 5 m. S.S.E. from Coyote Well,
- 272 about $\frac{1}{3}$ mile east of boundary monument 258 and 100 feet north of the boundary fence,
- 273 In next gulch N.E. of 272
- 274
- 275 South end of Soledad Mountain
- 277 San Diego, Balboa Park, southwest of the New Mexico building
Perhaps kitchen middens
- 278 A mile or more west of Encanto in a cut on the north side of Market St. 100 yards east of Euclid Avenue
- 341 a San Diego, Balboa Park, about $\frac{1}{4}$ mile south of the organ
- 342 San Diego, in a cliff graded for a private roadway at the eastern end of Paradise Valley,
- 344 Alverson Canon, Coyote Mts. Imperial County, near head of canon
- 345 " " " " $\frac{1}{2}$ mile above mouth of canon
- 346 Yuha Buttes, Imperial County,
- 347 ^B Alverson Canon
- 351 Coyote Mt. Imperial Co. 1 mile east of mouth of Alverson Canon,
- 353 San Diego, Upas and Columbia Streets,
- 354 Barrett Canon, Imperial County, 4 miles above Carrizo Carrizo Creek
- (355) India & Upas Streets San Diego,

Pliocene

No

358 San Diego, Balboa Park, Cabrillo Canon, $\frac{1}{4}$ mile above the bridge

360 Yuha Buttes, Imperial County

361 Old Mission, San Diego,

364

356-386-381 2 wayle

429, About $\frac{1}{2}$ mile east of the sea beach and 250 yards north of
the U.S. - Mexico boundary,

430 In next gulch NE from 429

Miocene

No

191 Laguna Beach, Orange County

192 " "

302 Santa Ana Mts. Santiago Canon, Orange County

303 " " " " " "

304 Laguna Beach, Orange County

305 " " " "

449 Dry Cañon just north of the head of Topanga Canon, Los Angeles County. Turritella ocoyana.

no Eocene

1 A. South end of Soledad Mountain.

2 " " " "

3 A " " " "

3 A " " " "

6 " " " "

8 " " " "

49

64a NE corner of Mission Bay

70 a 1 mile north of Loma Portal, N end of Point Loma ridge

90 $\frac{2}{3}$ mile east of Cardiff

91 Cardiff, west of highway

92 $\frac{1}{2}$ mile north of Cardiff, cliff at sea beach

93 North of Solano Beach, on R R right of way, San Elijo Lagoon.

94 Agua Hedionda Rancho, 2 miles south of Canon de las Monas.

94a " " " " " " " "

95 " " " NE of head of Canon de los Encinas

95a " " " "

130, At base of north end of Del Mar ridge, east of road to Rancho Santa Fe.

131 $2\frac{1}{2}$ miles NNE from Del Mar, in cliff n.w. side of " " " "

132 East of the bridge at Old Town, Sewer excavation

134 Torrey Pines ridge $\frac{1}{4}$ m S of Indian Trail

135 Torrey Pines

135a " " " "

138 San Clemente Canon, north side

139 South end of Del Mar ridge

140 300 yards east of Old Town bridge, Boulder

144 Old pumping station east of ~~Old Town~~ bridge

156 Agua Hedionda Rancho

157 " Mahogany Canon, San Diego

166 Shale bed in San Clemente Canon

Eocene

no

- 171 East slope of Soledad Mt. at Rose Canon
- 174 San Clemente Canon, south side $\frac{3}{4}$ mile above Rose Canon
- 179 North end of Point Loma ridge, 1 m from Loma Portal,
- 180 From a boulder, lower part of gulch, west end Mission Cliff Gardens
- 181 North side of Soledad Valley, 1 m w of Sorrento
- 182, Torrey Pines cliff at ocean
- 183 " " "
- 185 San Clemente Canon near city boundary
- 186 " " " " Rose Canon
- 194 Ticolote Canon, west side
- 195 " " east side
- 196 " " east fork
- 197 " " west side, Moreno grade
- 198 " " " "

- 272

- 276
- 352 Old Town, (Jamie Cooper)
- 355 India & Upas, San Diego.
- 356 San Clemente Canon, south side, about opposite 766
- 357 " " "
- 399, "Salt Creek," (Grant).

Cretaceous

- "
73 South shore of Todos Santos Bay, Lower California
152, Agua Hedionda Rancho, Canon de las Encinas
155 " " "
193 Point Loma, near Lighthouse
306 Santa Ana Mts, Silverado Canon,
307 " " " "
308 " " " Williams Canon
341 " " " Santiago-Aliso divide
363 Dry Lake, Nevada